



# BLACK SPOT DISTRIBUTION AND MANAGEMENT

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# Outline

- Disease symptoms
- Where has the disease spread?
- Disease cycle and suppression
- Fungicidal control
- Copper model



# THE DISEASE SYMPTOMS

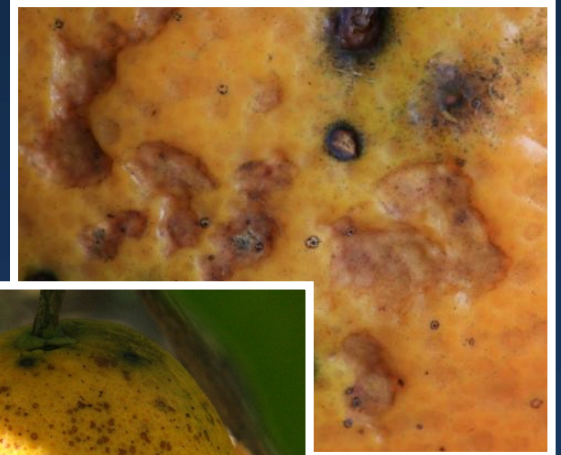
# Symptoms Occur on Maturing Fruit

- Unusual to see hard spot more than 2 months before maturity but infection months before
- Exposure to sunlight increases lesion number
  - Warm temps (~ 81°F; 27°C) also increase disease
- Symptoms generally occur on the 'sunny side of trees' *first*
- Warm weather stimulates symptom development
  - Saw symptoms Dec 2012 during warm weather
  - Symptom development slower in 2014 with cool temps

# Cracked Spot and Hard Spot



# False Melanose and Virulent Spot



# Leaf and Stem Symptoms

- Leaf symptoms uncommon but present at low levels with little or no control measures
  - Most commonly found on highly susceptible lemons
  - Can be found on any cultivar
  - Often on leaves near senescence
- Small reddish-brown lesions
  - Tan center forms as lesions age
  - Old lesions have dark brown margin sometimes with large yellow halo

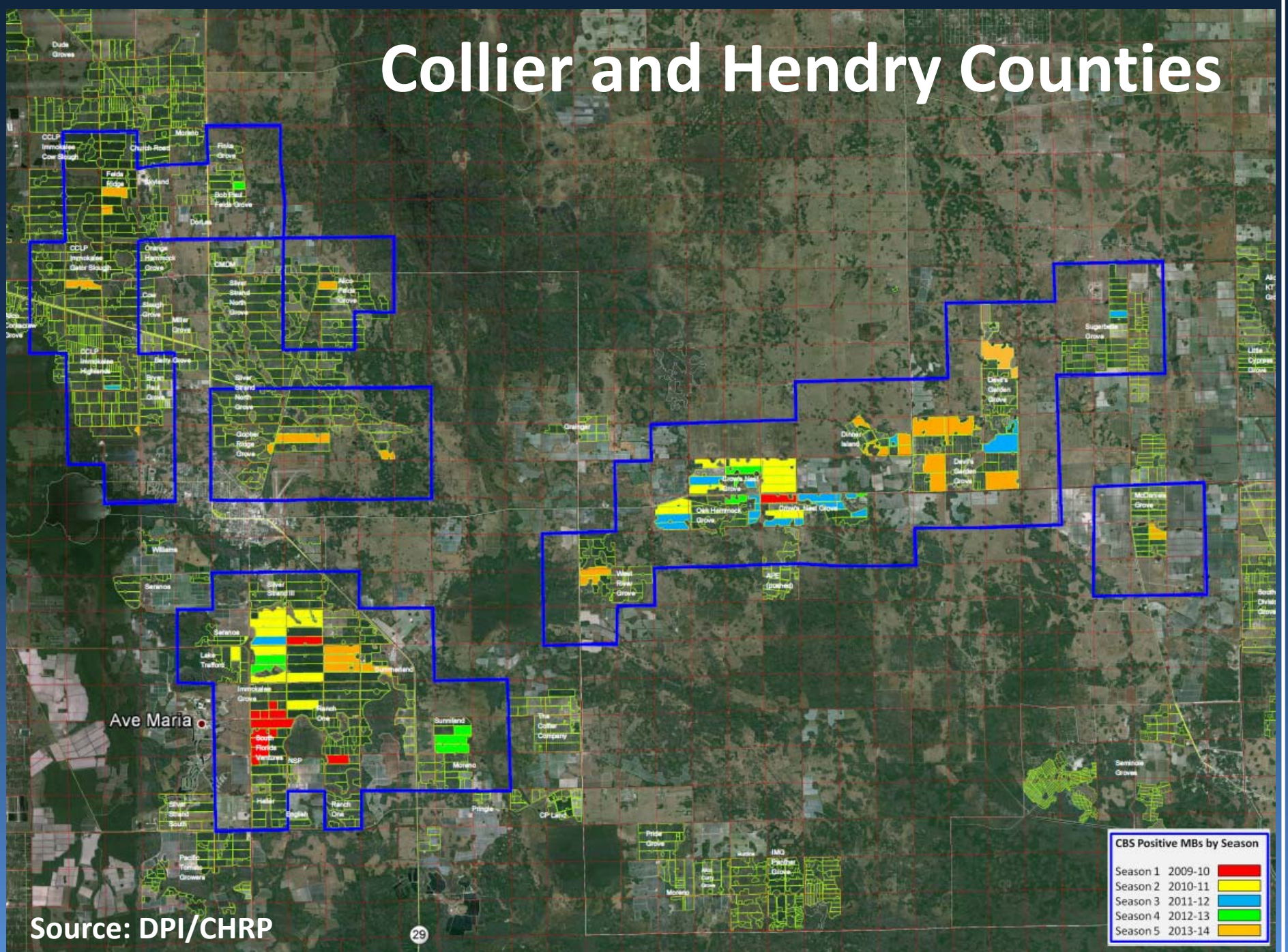
# Leaf and Stem Symptoms





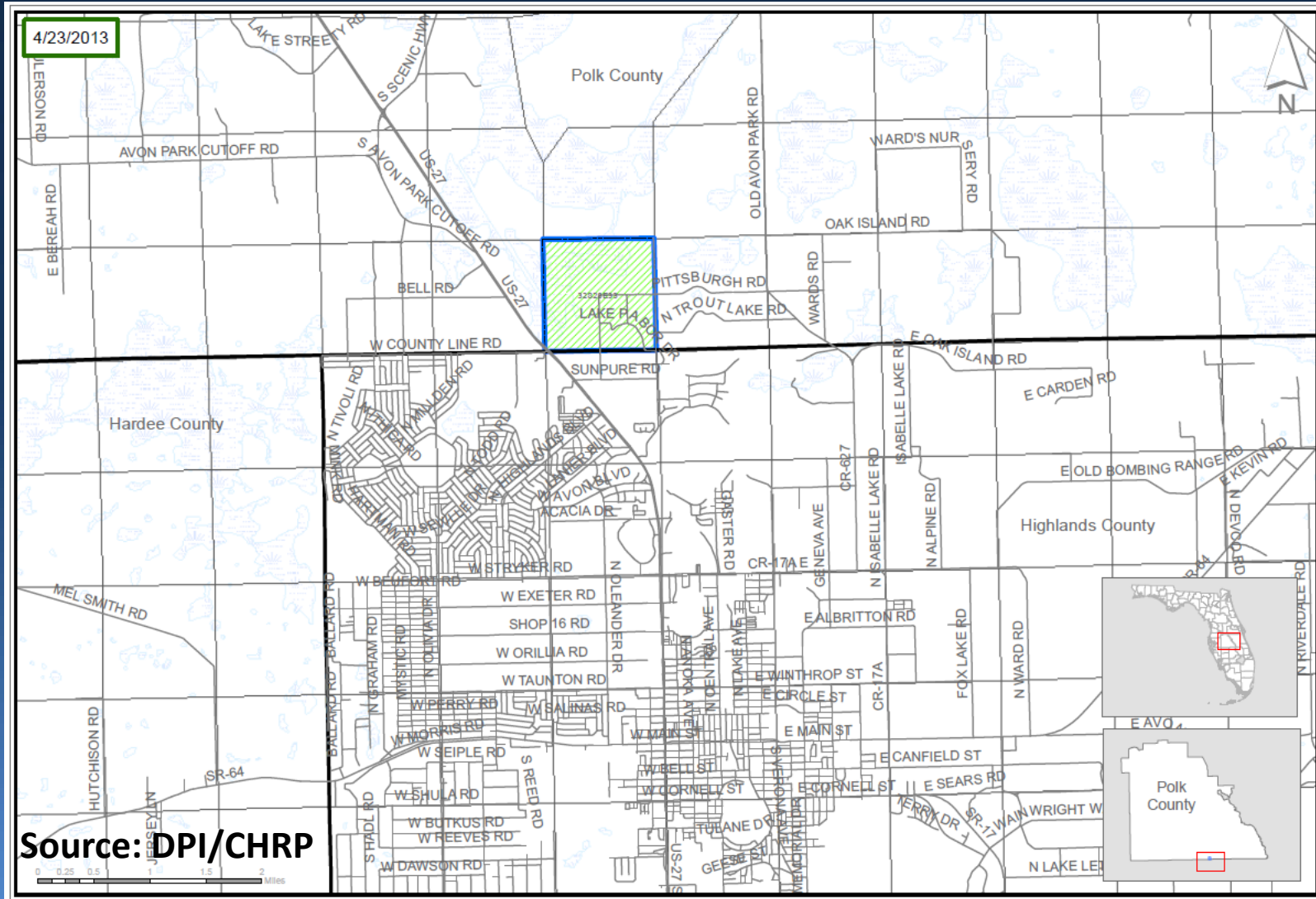
**WHERE HAS THE DISEASE SPREAD?**

# Collier and Hendry Counties



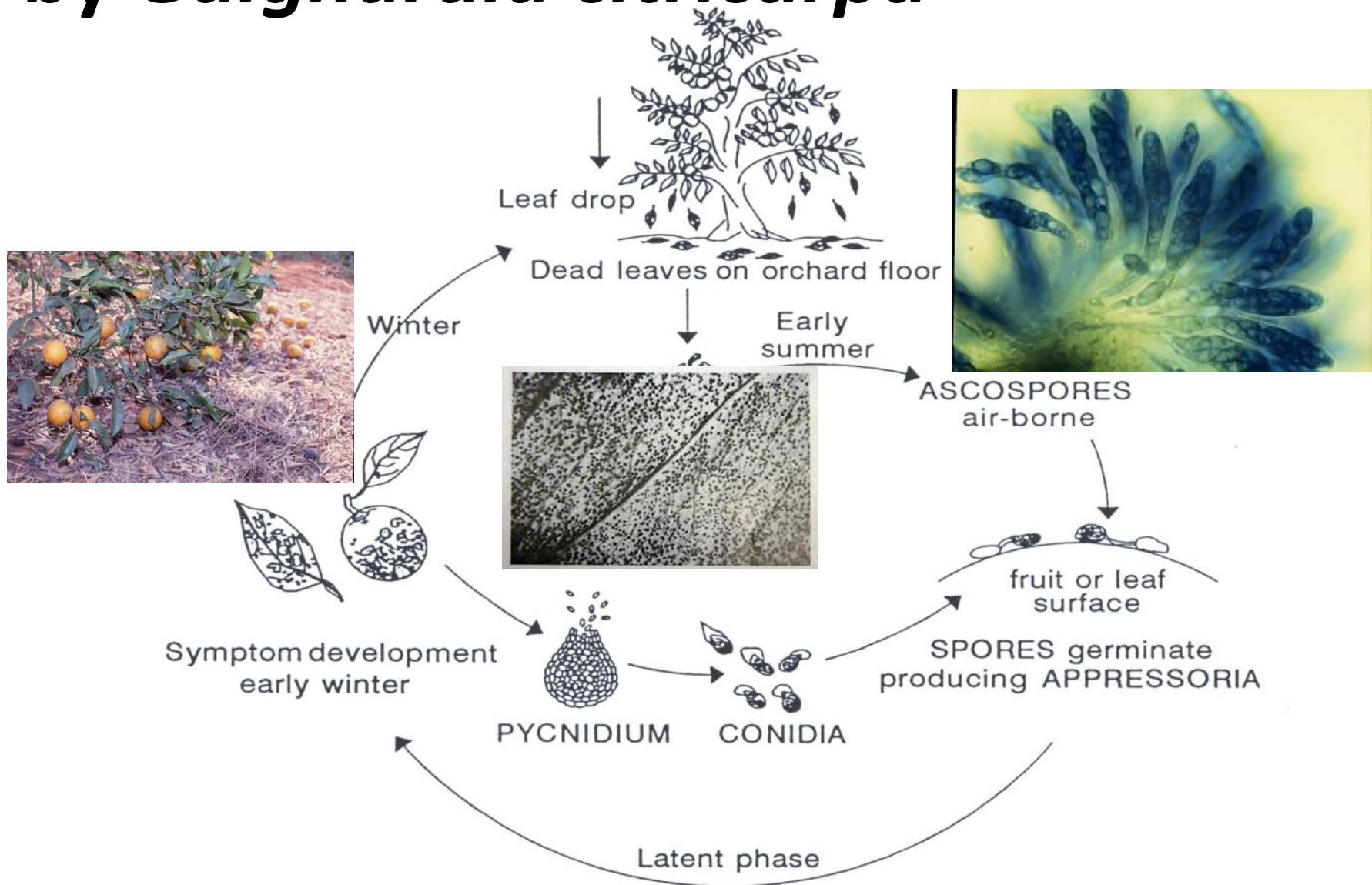
Source: DPI/CHRP

# Polk County Location



# **DISEASE CYCLE AND SUPPRESSION**

# Black Spot Disease Cycle Caused by *Guignardia citricarpa*



# Disease Cycle Highlights



- Major inoculum source: decomposing leaf litter (ascospores)
- Additional inoculum source: lesions on infected fruits, leaf litter, and branches (conidia)
- Means of spread: Wind (ascospores); Water splash (ascospores and conidia)
- Survival of the fungus: leaves, leaf litter branches, fruits, and peduncles

# Leaves Are Nearly Symptomless

- On oranges and tangerines, if chemical control used, symptoms extremely rare
- Does not mean leaves are not infected
  - Certain proportion will harbor the organism
- When symptomatic trees removed, not likely removing disease from grove
- Need to balance between cost of lost trees, likely replant success with HLB, and cost of living with black spot



# Plant Debris Movement

- Needs to be minimized to reduce spread
  - Tarping is necessary
  - Have seen tarping machine prototypes built
- All vehicles and equipment
  - Canker decontamination materials (quat) will work
- Fruit loads if possible as well
  - Noticing greater twig breakage during harvest recently





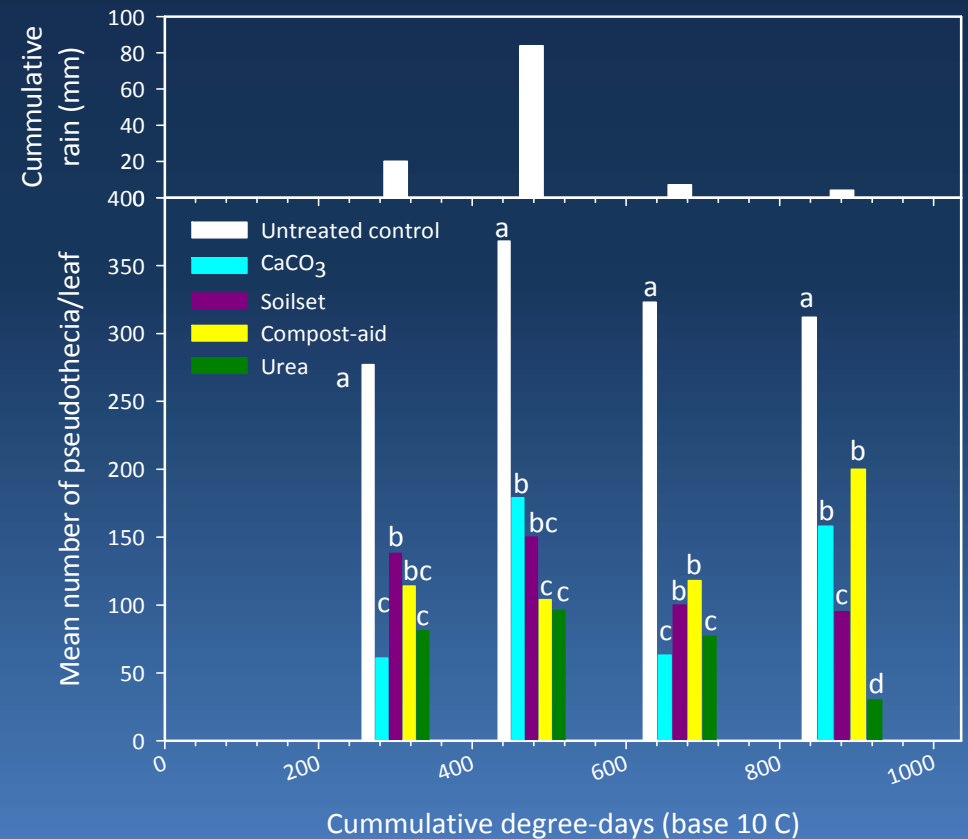
# Tree Health

- Declining trees are more symptomatic
  - More susceptible to disease
- Declining trees should be removed
  - Cause of decline unimportant
- Anything that can maintain tree health good practice
  - Nutritional
  - Pest and disease control



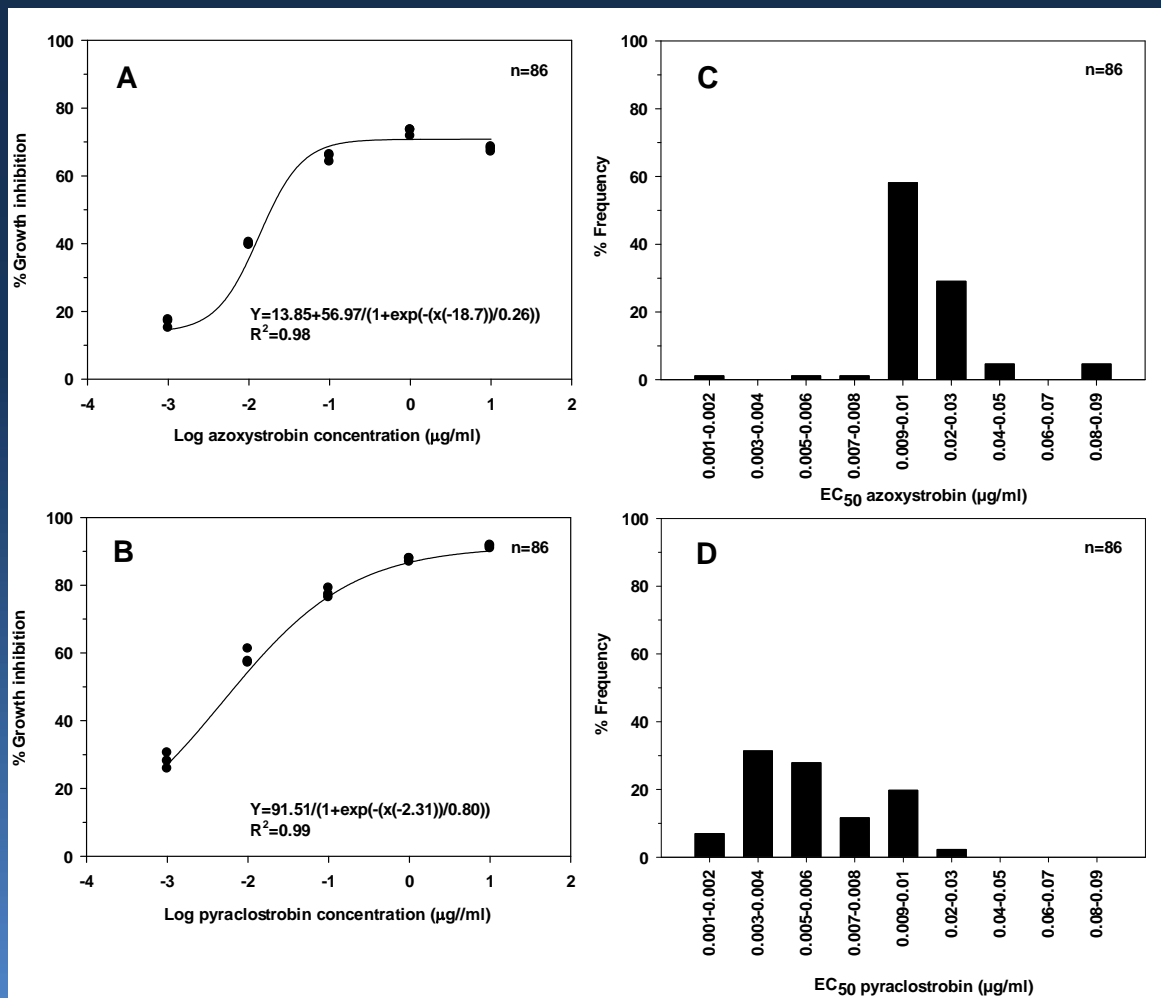
# Cultural Controls

- Leaf litter management
- 5% urea best treatment in small plots
- Large scale trials planned this spring
  - Confirming co-operators for this spring



# FUNGICIDAL CONTROL

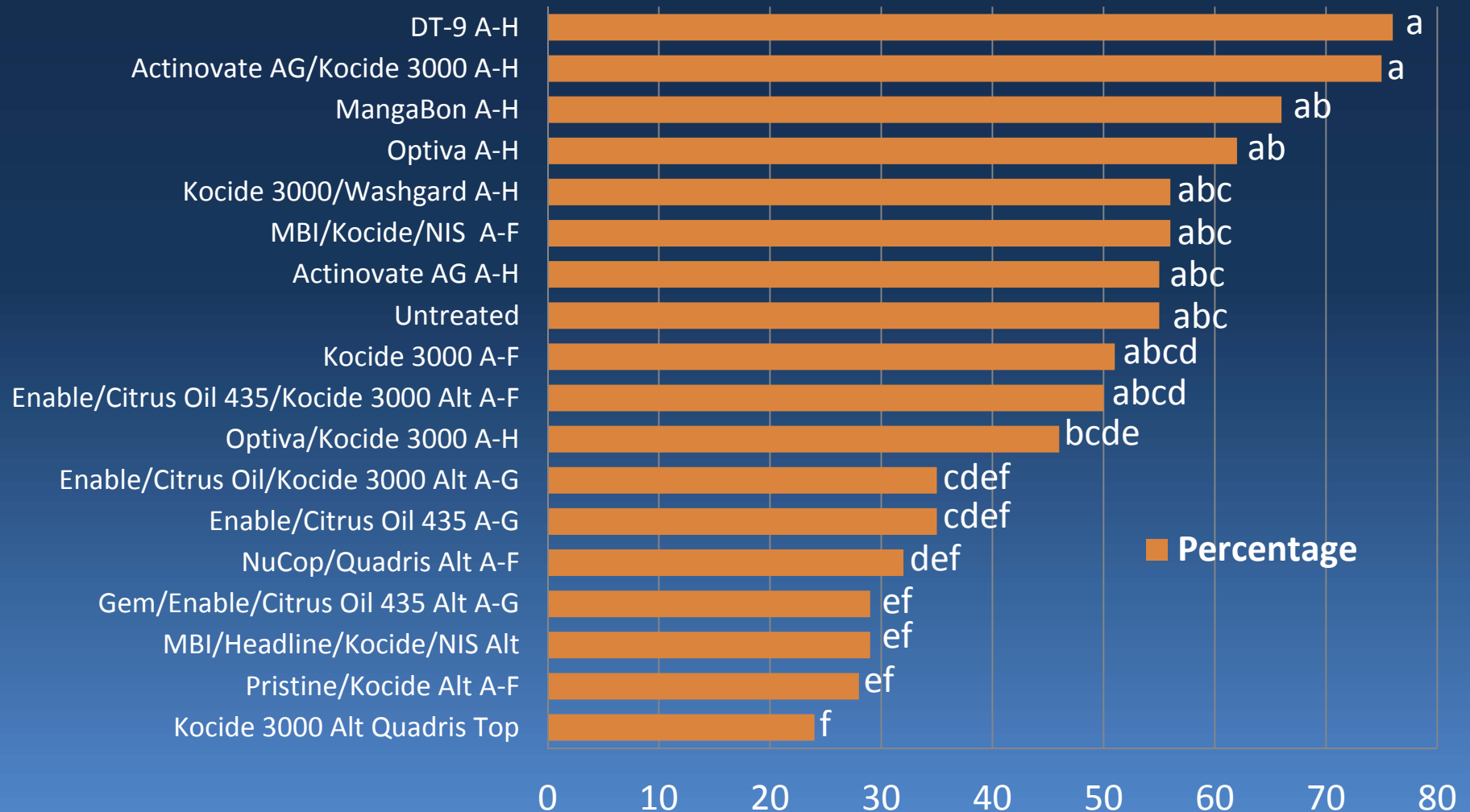
# In Vitro Assay for Native Sensitivity



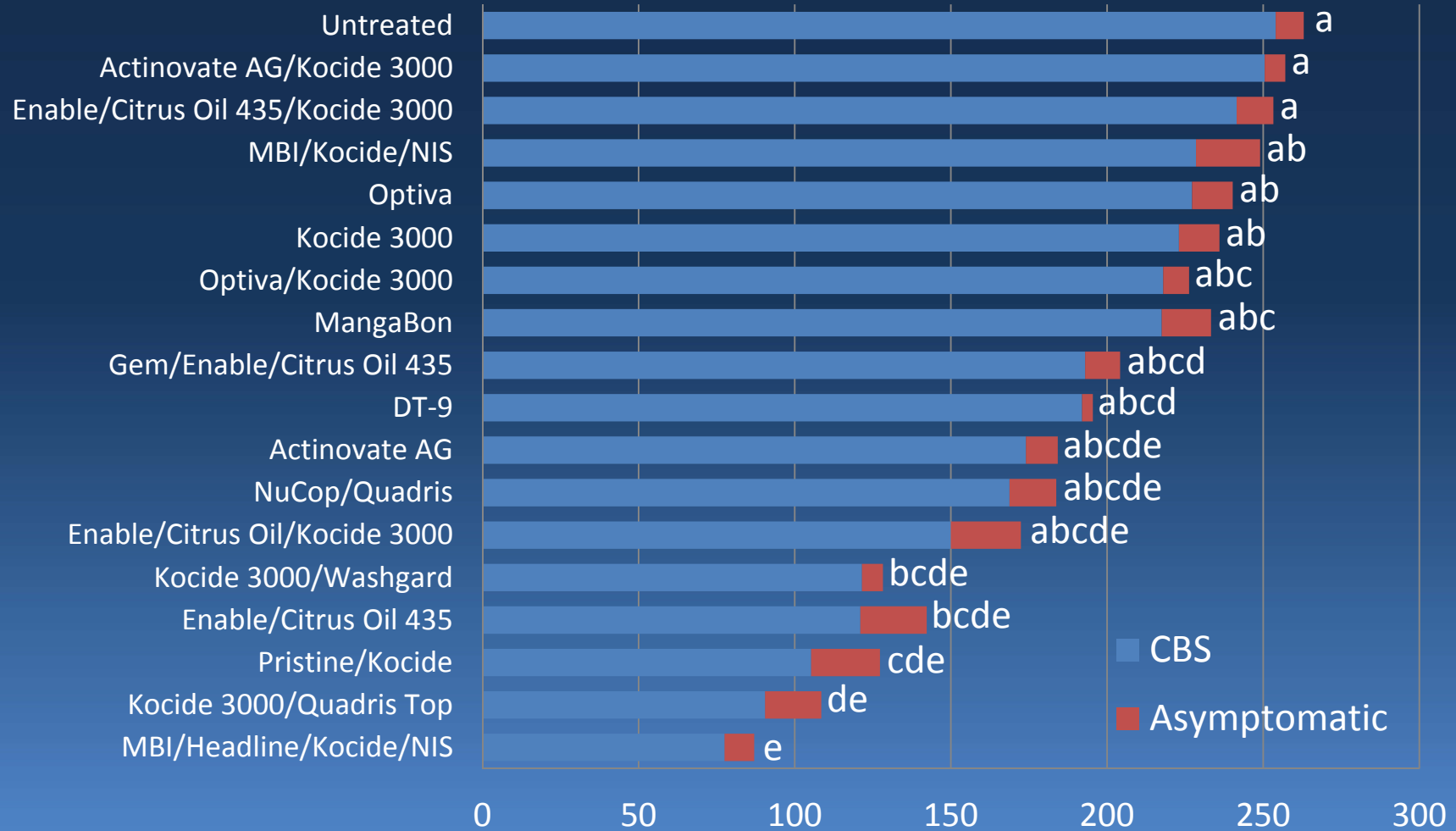
- Baseline study for strobilurins
- Mycelium highly sensitive to strobs
  - Spores even more sensitive
- Have this information for future resistance monitoring

# Percentage Fruit per Meter Square with CBS Lesions

## March 20, 2013 – Pam Roberts and KAC consulting



# Asymptomatic Fruit and Fruit with CBS Lesions on Ground, March 20, 2013 – Pam Roberts and KAC Consulting



# Summary

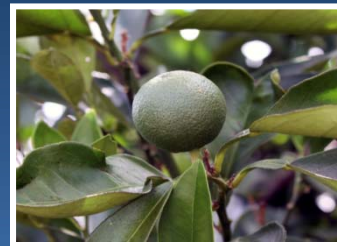
- Investigating products *in vitro* and in field for efficacy
  - Establishing baseline sensitivities to fungicides registered for citrus to be able to monitor for resistance development
  - Testing products *in vitro* prior to field trials
- Currently testing DMI fungicides
  - Testing 5 fungicides for efficacy and baseline sensitivity

# COPPER MODEL



# Copper Facts

- Copper residue is significantly reduced by rain washing
- Copper does not move once dried
- Copper residue is cracked by fruit growth



*As the fruit grows, copper must be reapplied to continually cover the fruit as it becomes larger*

# How The Scheduler Operates



- Incorporates rainfall data from FAWN (Florida Automated Weather Network-[www.fawn.ifas.ufl.edu](http://www.fawn.ifas.ufl.edu))
- Incorporates data on copper residue degradation
- Incorporates fruit growth size
- Calculates residue decay
- Florida specific data used for algorithms



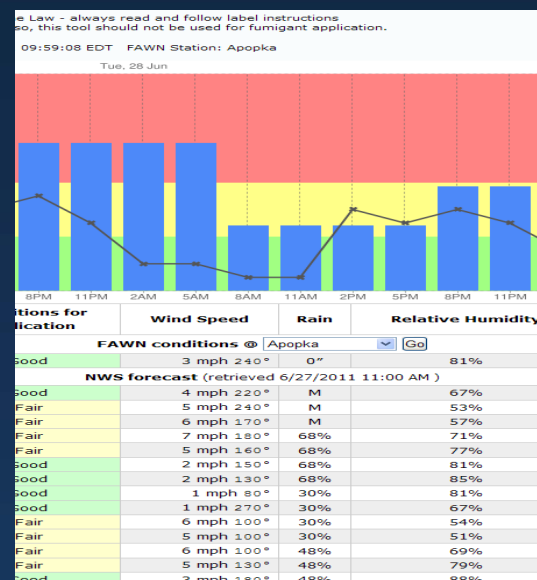
*The blue specks are copper residue*

# Proper Application of Copper

- Use label rate recommended for a disease
- Be cautious in hot weather ( $> 94^{\circ}\text{F}$ ;  $34^{\circ}\text{C}$ )
  - Phytotoxicity can occur more easily in hot weather
- Potential for phytotoxicity can be reduced with greater water volume per acre
- Complex tank mixes, oil applications, and nutritional materials contribute to phytotoxicity
- Aerial applications not likely to get adequate penetration of canopy for control, best method is with an air blast sprayer

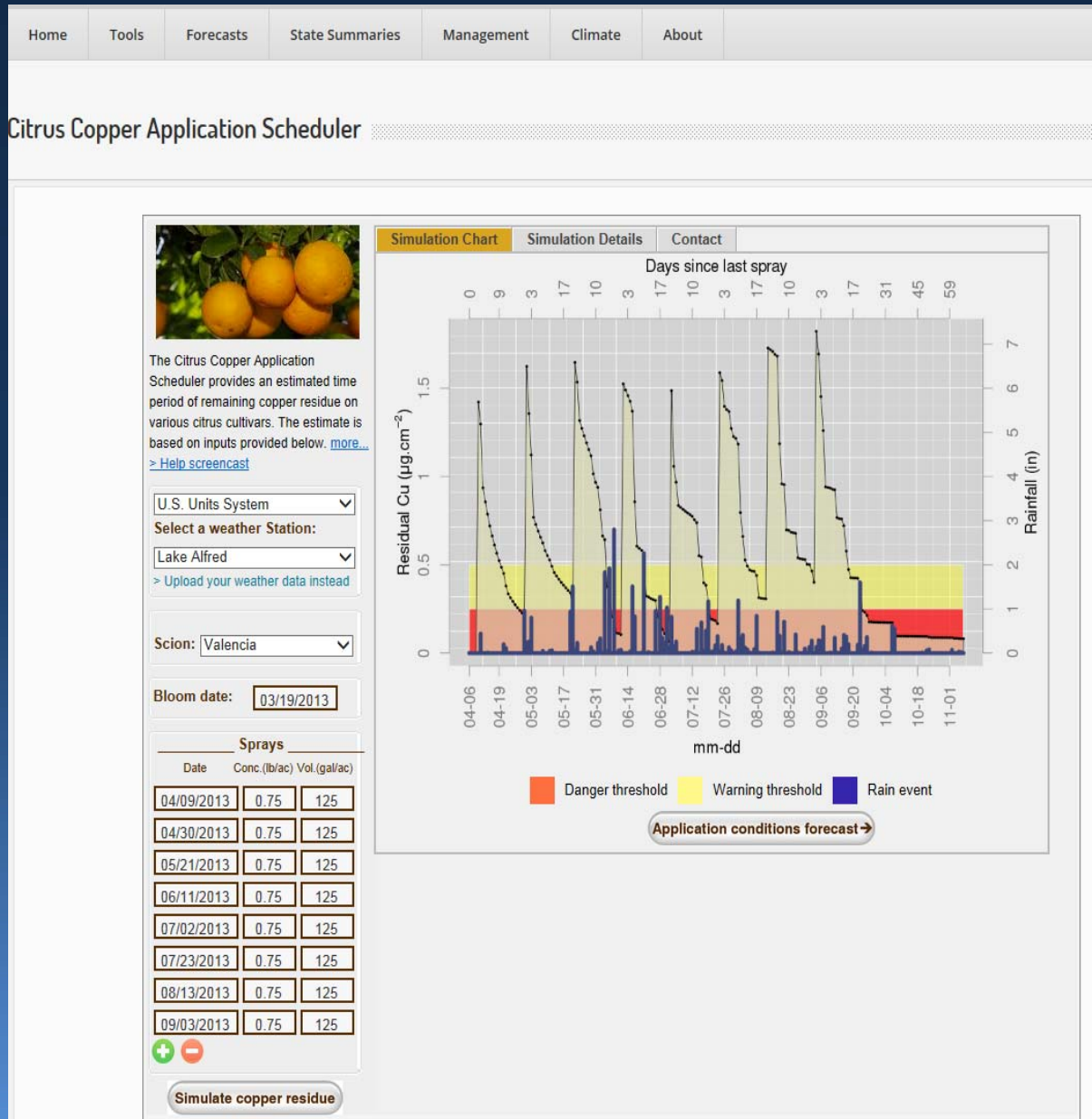
# More Modern Features

- Web-based
  - No longer a program saved on your computer
- Interface is user-friendly
- Easier data input
- Available from *AgroClimate* and FAWN websites
- Use in conjunction with the citrus pesticide application tool on FAWN
- Mobile version



# 21-day Calendar Schedule

- 2013 in Lake Alfred
- Scion: Valencia
- Bloom: 3/19/2013
- 0.75 lb metallic Cu in 125 gal/acre
- Significant gaps in coverage May, June, and July
- Peak control timing for greasy spot and melanose



# Applications Based on Model

- 2013 in Lake Alfred
- Scion: Valencia
- Bloom: 3/19/2013
- 0.75 lb metallic Cu in 125 gal/acre
- Applications when residue approached  $0.25 \mu\text{g Cu}/\text{cm}^2$  fruit area – RED
- Gaps in coverage eliminated without additional applications

## Citrus Copper Application Scheduler



The Citrus Copper Application Scheduler provides an estimated time period of remaining copper residue on various citrus cultivars. The estimate is based on inputs provided below. [more...](#)

[> Help screencast](#)

U.S. Units System

Select a weather Station:

Lake Alfred

[> Upload your weather data instead](#)

Scion: Valencia

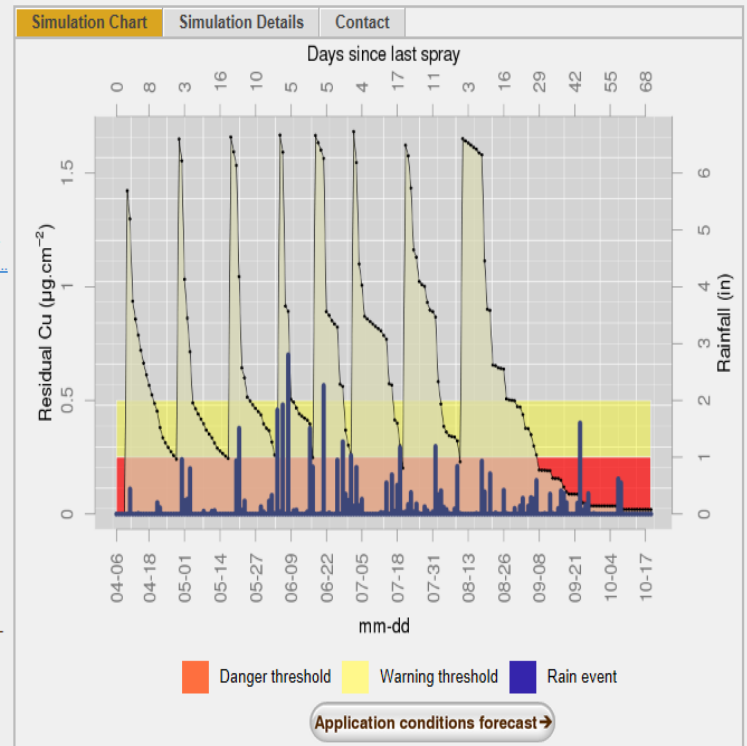
Bloom date: 03/19/2013

### Sprays

Date	Conc. (lb/ac)	Vol. (gal/ac)
04/09/2013	0.75	125
04/28/2013	0.75	125
05/17/2013	0.75	125
06/04/2013	0.75	125
06/17/2013	0.75	125
07/01/2013	0.75	125
07/20/2013	0.75	125
08/10/2013	0.75	125



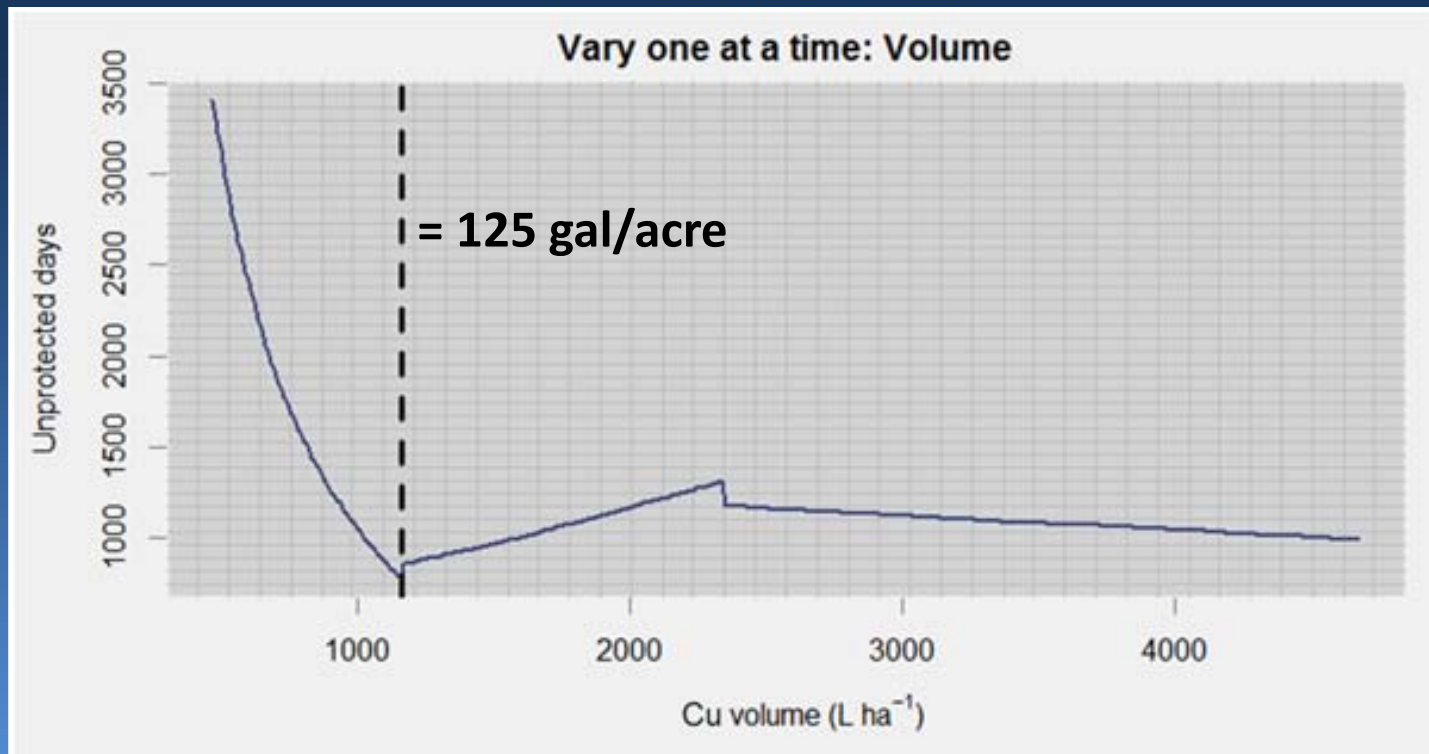
Simulate copper residue



# What Application Volume is Best?

- All variable kept same except volume
  - 0.75 lb metallic copper, 21-day application schedule, mandarin scion, inside canopy fruit
- Run over 55 years of data

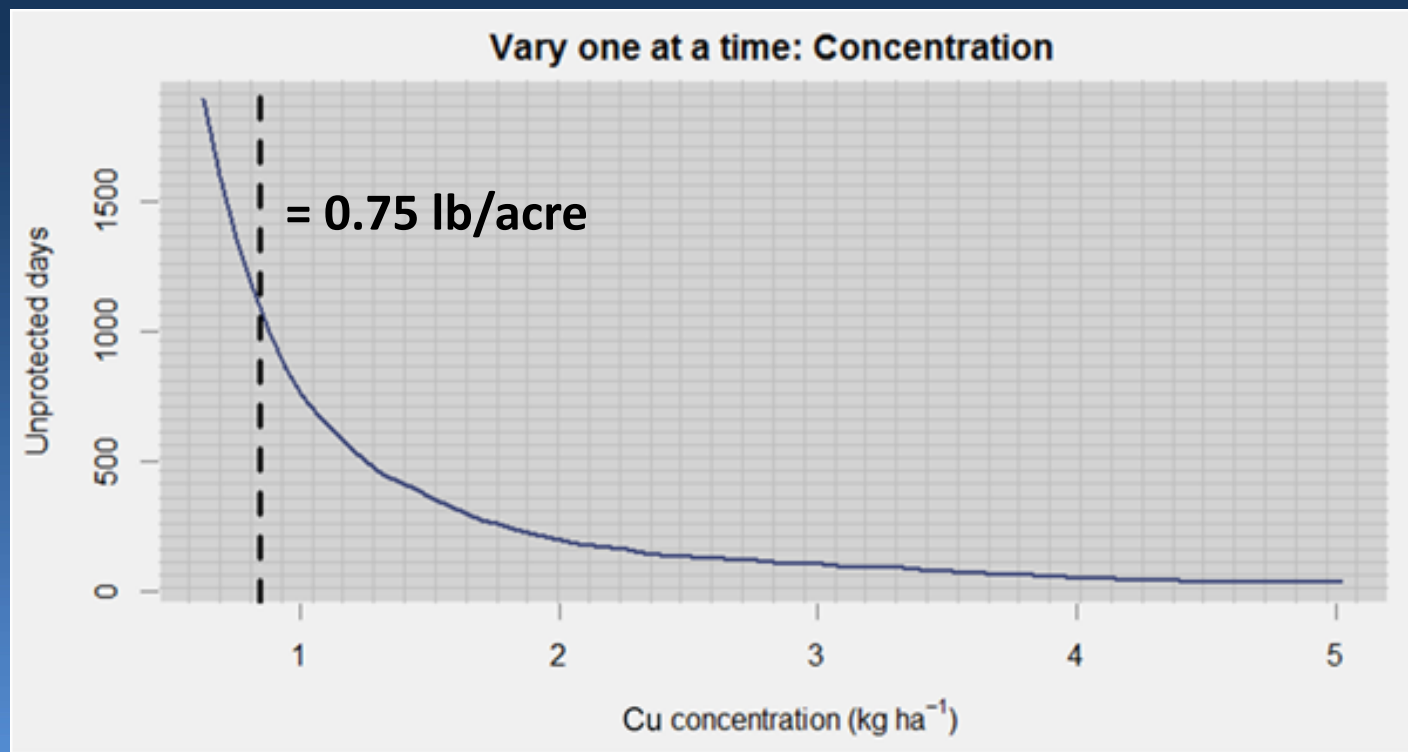
Zortea et al. 2013



# Copper Concentration Range?

- All variable kept same except concentration
  - 125 gal/acre, 21-day application schedule, mandarin scion, inside canopy fruit
- Run over 55 years of data

Zortea et al. 2013

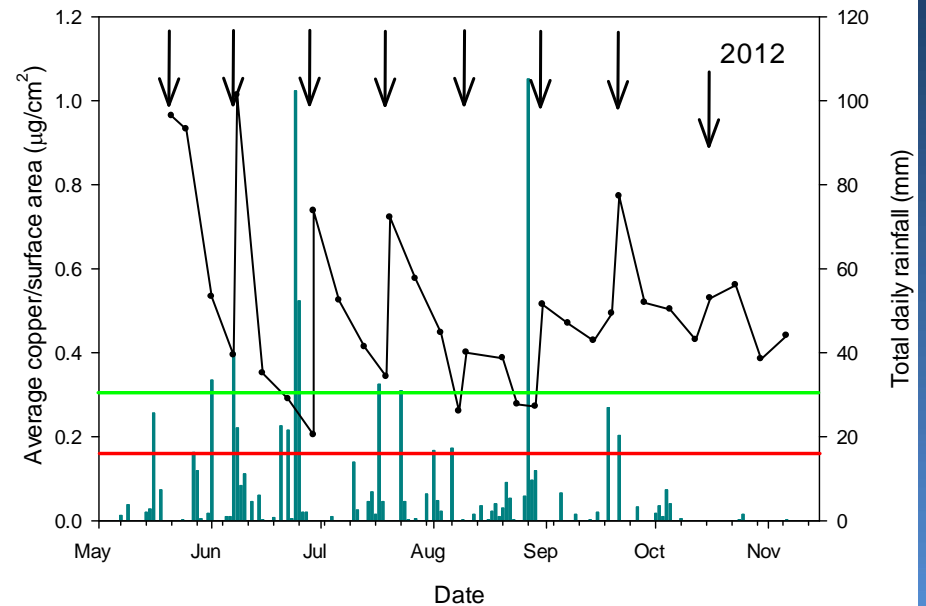
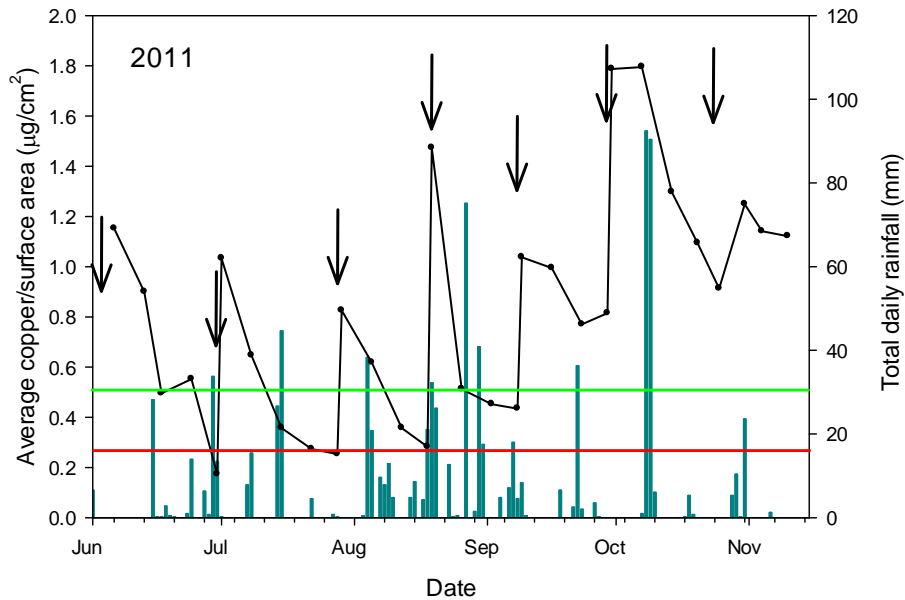




# Conclusions

- The current 21-day calendar schedule is not optimally timed in most years to protect fruit
- The Citrus Copper Application Scheduler can, in ideal conditions, further increase the protection and save sprays in dry years
- Can be used with the citrus pesticide application tool to best time applications
- Was able to confirm that 125 gal/acre and 0.75 lb/acre application volume and rate was optimal for application efficiency

# Copper Residue Valencia - Summer



# Future Plans

- Incorporate additional fruit growth data
  - Three seasons collected
  - Residue data will continue this year with addition of new copper formulation cuprous oxide
- Potential Features – still in progress
  - Allow data to be stored on a server to avoid inputting the information every time
  - Send alerts, as requested
  - Login service

# Greater Management Efforts

- No easy fixes or solutions
- Will require an integrated approach
  - Leaf litter management
  - Fungicide applications
  - Use tools to aid application timing
  - Removal of declining trees
- Will not be able to rely on one management method

# Acknowledgements



- Work was generously supported by CRDF, APHIS, Citrus Initiative, and Syngenta Crop Protection



- Others who have assisted
  - Sachindra N. Mondal
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